DOOSAN Document Transmittal

Upper Trishuli-1 HEP (216MW)

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1	RN-0205	AN	UT1-C-060-CVL-DG-43001	0A	Layout Drawing of Work Adit for Steel Penstock Tunnel	
2	RN-0206	RR	UT1-C-070-CVL-DC-59002	0	Numerical Simulation Analysis for Tailrace Tunnel	
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Legend of Review Status
A : APPROVED
AN : APPROVED AS NOTED
RR : RETURN FOR RESUBMISSION
FI : FOR INFORMATION

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Doosan Enerbility Co., Ltd
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Discipline : Civil

UPPER TRISHULI-1 HEP (216MW)

Client	**Nepal Water and Energy Development Company Private Limited**
Owner's Engineer	**Tractebel Engineering GmbH / Jade Consult**

REVIEW NOTE

Contractor	**Doosan Enerbility**		
Title of the Document	Numerical Simulation Analysis for Tailrace Tunnel		
Document No.	UT1-C-070-CVL-DC-59002	Revision	0
Date of Documents	25.07.2022	Received Date	26.07.2022
Transmittal Form No.	UT1-HEP-DHI-D-0316		
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A: Approved AN: Approved as Noted RR: Returned for Resubmission FI: For Information, only

Introduction

The report under this revision is marked as "Draft Report". During the Weekly Progress Meeting No. 15 on 28/7/2022 the EPC Contractor stated that the final report will be submitted for revision on 29/07/2022. OE submitted an Email as reminder on 30/07/2022 to the EPC Contractor. However, until date the final report has not been submitted yet. It has been combined with the EPC Contractor that OE´s comments to the "draft" report will be submitted herewith.
The EPC Contractor shall respect and include the following comments into the final version of the Numerical Simulation Analysis for Tailrace Tunnel.

Further delay of submission of the final report will have direct impact on construction progress of the Tailrace System!

Summary

The report contains valuable first results, which provide first indications of the flow conditions in the river reach at the tailrace and within the tailrace outlet, however, needs to be complemented. In general, results are presented without clear conclusions or an assessment of the potential impacts on the safe and sustainable operation of the hydropower plant.

Besides above it must be stated that the bathymetric data base seems to be inappropriate for the purpose of a 3D-modelling, which also impairs the significance of the results. Thus, a new bathymetric survey, on which basis the CFD simulations of the river are updated is desirable.

Comments

Section 1.8 - Site Visit
Page 7:
It is mentioned that during the site visit a clear indication of a problem with the contour maps, compared to the actual terrain, was observed. Please explain what the problem is and what the impact on the numerical model results might be by using the available contour maps, developed and supplied by the Client.

Section - 2.2 Inputs

Page 9:

- It is mentioned that the maximum of monthly flow data was used to check the current measured flow at site. The model calibration and validation should not be done for a single discharge but over a full range of discharges, covering flood discharges as well as regular discharges.
- Please provide the results of the model calibration and the validation in detail.
- Which roughness values were used for the river bed surfaces?

Section 2.3 - Initial runs

Page 10:

- With the downstream model boundary being only 200 m away from the location of interest, has the impact of the downstream boundary condition on the flow conditions at the location of interest been checked?
- Which downstream boundary condition was used?

Page 12 (Figure 12):

- It is unclear at which locations the shown cross sections of Figure 12 are, the numbers provided in the annotation cannot be linked to sections shown in the layout map.
- Please indicate the flow direction, i.e. on which side which bank is.
- The variation in water levels across the cross section is extreme with water level differences in the range of up to 8 - 9 m. Even at large discharges with high velocities and secondary flow phenomena due to the bend river this appears questionable.
- Further, with such turbulent flow conditions it is expected that there is no real steady state in the shown cross sections. Please show and describe also flow conditions at other time steps with another flow pattern, if any.
- It is mentioned that *„it is suggested to have very detail bathometry survey data with proper guidance“*. What does this mean for the significance of the simulated results. Are they considered to be reliable or not? Is it planned to execute a bathymetric survey to improve the data base and thereby improve the accuracy and significance of the results in a subsequent step?

Page 13 (Figure 13):

- For Figure 13 the same comments apply as for Figure 12, above.
- There is water on the left bank at Section 390. How is the water coming up there? Was there higher water flow in the upstream? From the flow pattern shown in the cross section this cannot be explained.
- No interpretation of the results is provided, e.g. with regard to the operation of the power plant, the risk of sediment intrusion into the tailrace canal during floods etc. For assessing the latter, it would be helpful to provide arrows, indicating the flow directions across the cross sections.

Page 14 (Figure 14):

- It is unclear what the rationale of Figure 14 is. Please provide an explanation of the figure and what the impact on the project is.
- Further, make a clear distinction between supercritical (Fr>1) and sub-critical flow (Fr<1) in the figure.

Section 2.4 - Design floods at Tailrace outlet

Page 15:

- In the text it is referred to a rating curve in Figure 15. However, this is rather a time series of water levels (water level development over time). It is unclear at which location this time series occurs. Considering the large differences in water surface elevations across the cross sections shown in Figure 13, the time series would look very different in the middle of the section compared to the left or right bank of the section. Therefore, please show the exact location on a layout map.
- Further, there are sudden water level peaks in the time series. What is the reason for these peaks and what could be the impact on the power plant operation?
- In addition, please provide a real rating curve, showing the water levels as a function of the discharges (WL vs. Q).
- Then, please compare the simulated rating curve with the rating curve which was measured in the field.
- Also, please compare the simulated rating curve with the rating curve which was used for the design.

- Please explain what the statement *"It seems that the terrain is quite unusual on the flow regime developed."* means, what the impact on the project could be and what mitigation measures can be taken.

Section 2.7 - Flow during 1000 yrs flood

Page 17:

- It is stated that *"The flood elevation at mid of the river is more than 919 but at the tailrace outlet bank, the elevation is about EL 918. This is higher than obtained on design phase."*.
  - The flow conditions during a 1,000 yrs flood shown in Figure 19 rather suggest water surface levels in the range of 914 masl in the middle of the river and 912 masl at the tailrace outlet bank. Please clarify.
  - What were the water levels used in the design phase and what is the impact of the higher water levels on the power plant operation?

Section 3.4 - Output

Page 22 – 24:

- There are two cross references "figure XX". Please update.
- In general, please provide a written description of the results.
- Please provide the development of flows **and pressures** during the transient events at meaningful locations along the tailrace tunnels, e.g. at the draft tube outlet, up- and downstream of the tailrace surge tanks, up-and downstream of the confluence, along the combined tailrace tunnel, incl. one close to the interface of pressure flow and free surface flow.
- Please execute a simulation with a load acceptance and load rejection only, respectively, and examine the development of flow conditions at the interface between the pressure flow and fress surface flow over the time. Does the interface remain at the same location or are there surge-like phenomena, leading to a movement of this interface?
- Please also provide the results and a written description of the results for the other scenarios.

Section 4.1 - Tailrace Outlet

Page 25 – 26:

- A variation in water level of 2-3 m is mentioned, however, on Figures 12 and 13 the difference in water level within one cross sections appears to be up to 8-9 m.
- We agree to the statement that accurate bathymetric cross sections need to be surveyed and that the numerical model needs to be re-run on this basis. It doesn't make sense to develop a multidimensional CFD model if the data base is unsatisfactory. The significance of the results can only be as good as the input data is.
  - What is the plan and status on the survey of new bathymetric data?
- The comparison of measured and simulated water levels is not clear. Please provide a better description to enhance the understanding of the good match between simulated water levels and measured water levels in July 2022 and the mismatch for higher discharges. For example, the measured water levels could be superimposed to the figures showing the simulated water levels.

Section 4.2 - Tailrace Tunnel

Page 27 – 28:

- The conclusions are not clear and target-oriented.
- What is meant by *"the transient behaviour is within the range of operation"*?
- One conclusion is that the surge chamber is not performing as hydraulic control structure.
  - What is meant by hydraulic control structure in this context?
  - What is the consequence from this observation?
  - Is a re-design of the tailrace surge chambers required? If so, in which way?
- In which way are the water masses at the junction of the three tunnels *"playing a critical role"*? Please elaborate the critical points and the potential impacts on the plant operation in detail.
- Were the river water levels simulated in the river model used as downstream boundary condition for the tailrace tunnel model? For example during July the river water level seems to be in the range of 908 masl. Such a water level would presumably reduce the flow velocities at the drop downstream of the tailrace outlet.
- What is the energy level (pressure head + velocity head) at the tailrace outlet?

Disclaimer:

Any approval will not release the Contractor from any of his obligations under the Contract. Despite the Engineer's approval the Contractor remains fully responsible for design, calculation, dimensioning, supply and installation without limitations.

Sebastian Beck, Chief Design Engineer

Hannes Blindenhoefer, Hydraulic Expert